REPORT OF WATER QUALITY IN MITCHELL LAKE

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Ministry of the Environment

The Honourable
William G. Newman,
Minister

Everett Biggs,
Deputy Minister

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REPORT OF WATER QUALITY

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PREFACE

The Province of Ontario contains many thousands of beautiful small inland lakes which are most attractive for recreational use. Lakes close to urban areas and accessible by road often receive heavy use in terms of cottage development, camp sites, trailer parks and picnic areas.

A heavy influx of people may subject a lake and its surrounding environment to great stress. In many cases, developments are carried out on attractive lakes only to find that when this is complete the lake qualities which were initially so appealing have been damaged. The appearance of the shoreline can be marred by construction, fishing ruined by over-harvesting or the growth and decay of excessive amounts of algae and weeds. Motor boats introduce noise and petroleum pollution. Inadequate disposal of human wastes can place a great stress on the lake environment.

The accepted custom of having "a place at the lake" continues to apply pressure for more development, giving rise to an ever greater expansion of problems.

The Ontario Ministry of the Environment is attempting to bring some of these stress factors under control with a variety of programs. The cottage pollution control program was initiated in 1967 and was expanded in 1970 in order to solve the cottage waste disposal problem in recreational lakes. There are three on-going studies being carried out by the Ministry:

(1) Evaluation of existing waste disposal systems and enforcement of repairs to those found to be unsatisfactory;

(2) Research to improve the knowledge of septic tank operation and effects in shallow soil areas and evaluation of alternative methods of private waste disposal;

(3) Evaluation of present water quality in a number of recreational lakes.

A totally undeveloped lake near Huntsville was studied in 1972, in order to obtain more information about natural water quality conditions within a Precambrian Lake, which would assist in defining any unnatural conditions encountered in the developed lakes surveyed.

This report on Mitchell Lake is one of a series dealing with the water quality aspects of the recreational lakes studied in 1972. As well as defining the present status of water quality in the lakes, the data are meant to provide an historical reference for comparison of conditions at any future time.

SUMMARY

Surveys were carried out in Mitchell Lake in June, August and September of 1972 to evaluate the present status of the water quality with respect to bacteria, algae and aquatic plant growth. Additionally, plant nutrient, mineral chemistry and dissolved oxygen concentrations in the surface and bottom waters were determined.

The lake is located in the County of Victoria and the surrounding terrain is characterized by flat to gently rolling topography with a variety of soil cover. Generally, the soil cover is shallow and is composed of a sandy to clay loam till over a limestone bedrock.

Mitchell Lake generally was characterized by good bacteriological water quality throughout the three surveys. However, a high total coliform level was encountered in the northern part of the lake in the spring, exceeding the Ministry of the Environment's criterion. Since corresponding increases in fecal coliform and fecal streptococci were not detected, the high total coliform concentrations probably reflect natural conditions. During the fall survey, a significant source of pollution having very high fecal coliform levels was noted in the extreme eastern portion of the lake, with the influence of the Trent Canal and Grass Creek. Additional field efforts will be necessary to determine the source of this pollution.

The water chemistry of Mitchell Lake showed good quality with no dissolved oxygen depletions throughout its shallow depth. Total phosphorus and total Kjeldahl-nitrogen concentrations were generally far below those concentrations generally associated with troublesome amounts of suspended algae. The lake was characterized by small quantities of suspended algae but with the exception of the navigation channel, was heavily overgrown with aquatic plants.

PURPOSE OF THE SURVEYS

The surveys were designed, and tests selected, in order to evaluate the present conditions in the lake with respect to:

-inventory of lakeshore development
-distribution and concentration of bacteria
-water quality with depth
-plant nutrients and algae
-density and species of aquatic plants

As a result of human activity in the recreational lake environment, some wastes may reach the lake and can lead to either or both of two major types of water quality impairment - microbial contamination and/or excessive growths of algae and aquatic plants. The two problems can result from a common source of pollution, but the consequences of each are quite different.

Microbial contamination by raw or inadequately treated sewage does not significantly change the appearance of the water but poses an immediate public health hazard if the water is used for drinking or swimming. This type of pollution can be remedied by preventing wastes from reaching the lake and water quality will return to satisfactory conditions since most disease causing bacteria do not persist in the lake.

Nutrient enrichment, or eutrophication, results from the addition of plant fertilizers which occur naturally and are also present in virtually all forms of raw or treated human wastes. High concentrations of these fertilizers (plant nutrients), mainly nitrogen and phosphorus, support extensive growths of rooted aquatic plants and of microscopic free-floating plants called algae. Eutrophication greatly affects the lake appearance but generally does not pose a health hazard. Problems due to nutrient enrichment are generally long lasting and may become irreversible.

Changes in water temperature, dissolved oxygen and quality with depth are very important characteristics of a lake and were examined in the surveys.

The growth of weeds along the shoreline was noted during the surveys. Aquatic weed beds provide shelter and food for many kinds of fish. Too much growth is undesirable since it can upset the oxygen balance in the lake and can interfere with recreational uses of the lake.

DESIGN OF THE SURVEYS

Timing

Five day bacteriologial, chemical and biological surveys were carried out from June 8-12, August 26-30 and September 24-28, 1973, on Mitchell Lake.

A proper estimation of the bacterial population requires several measurements over a period of time which can then be averaged as a geometric mean. Measurements over five consecutive days at 13 sampling sites were considered to be the minimum number which would give reliable bacterial data.

Surface water chemical samples were collected on the first and last days of each survey at three inlet and one outlet stations and on the first, third and fifth days at the single mid-lake station. Additionally, chemical samples were secured from near bottom at the mid-lake sampling site. Chlorophyll a samples were collected each day at the inlet and mid-lake stations.

Field Tests

The temperature and dissolved oxygen values were measured at the deep water station with an electronic probe lowered into the lake. Water clarity was measured with a Secchi disc (Figure 1). The pH and conductivity of the samples were also measured in the field.

Bacteriological Tests

Three groups of bacteria were determined on each sample: total coliforms, fecal coliforms, fecal streptococci. These organisms are used as "indicators" of fecal contamination. Many diseases common to man can be transmitted by feces, consequently, the probability of occurrence of these diseases is usually highest in areas where the water is contaminated. The total coliforms, fecal coliforms and fecal streptococci organisms are all indigeneous to man and other warm-blooded animals and are found in the colon and feces in tremendous numbers. These indicator organisms in the water denote the presence of fecal contamination and hence the risk of disease causing organisms.

Chemical Tests

Hardness, alkalinity, chloride, iron and conductivity were measured in order to define the mineral composition of the water. The types of plants and animals which thrive, effects of toxic materials and suitability of the lake for various management techniques depend on the mineral content.

Both total and soluble phosphorus were measured in the inlet and bottom water samples while total phosphorus only was measured in the mid-lake and outlet surface samples. Soluble phosphorus concentrations are used mainly to substantiate various interpretations of the total phosphorus concentrations.

The total Kjeldahl nitrogen is essentially the amount of nitrogen contained in organic material. It was measured in all of the chemical samples. The soluble forms of nitrogen: ammonia, nitrite and nitrate were measured in the inlet and bottom water samples. They are particularly important in bottom waters since nitrogen is regenerated from decaying organic matter in these forms.

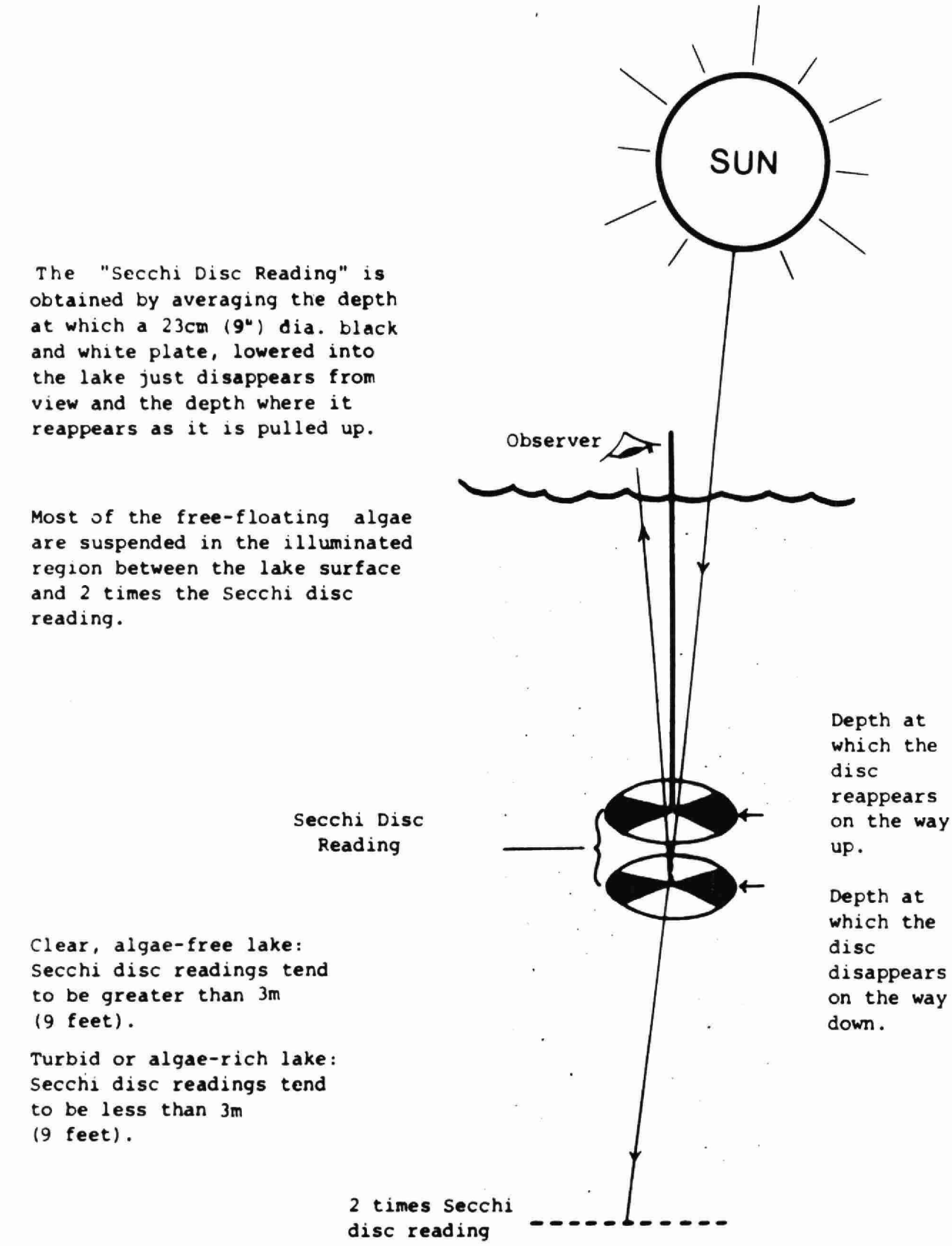


FIGURE 1: USE OF SECCHI DISC TO DETERMINE WATER CLARITY

Chlorophyll a concentrations are an indication of the amount of algae in the water. The live algae are confined mainly to the lighted surface waters which extend down to a depth of about twice the Secchi disc reading. The chlorophyll a samples were collected by filling the sample bottle as it was lowered and raised through the depth of the illuminated surface waters. The sample was then representative of algal densities through the sampling depth.

DESCRIPTION OF THE MITCHELL LAKE AREA

Soil and Lake Characteristics

Mitchell Lake is located in Eldon Township in the County of Victoria approximately 56 kilometers (35 miles) north of Lindsay. The surrounding terrain is characterized by flat to gently rolling topography with the overburden made up of five main soil series. The series which developed from calcareous loam (i.e. a sandy loam till) are the Otonabee, Bondhead and Dummer soils. The Otonabee soils are among the most important agriculture soils occurring in Victoria County. Such soils are well-drained with short steep slopes giving the area a rugged appearance. Bondhead soils are also well-drained and have a moderately rolling topography. Dummer soils are well-drained and the topography varies from moderately to steeply hilly where the till is deep. The Wendigo soils are developed from glacial outwash, are well-drained and found on gently to moderately sloping topography. Farmington loam is formed from shallow till over limestone bedrock. This soil has less than one foot of glacial till and occurs as broad level tablelands, broken by the occasional escarpment or rock ledge.

Mitchell Lake has a surface of approximately four square kilometers (two square miles) with a maximum depth of three meters (10 feet), and a shoreline

length of 18 kilometers (12 miles). The lake lies in a north-south axis with Highway 46 traversing it (Figure 2). The Trent-Severn channel crosses the lake from east to west with many patches of dense weeds and submerged stumps both north and south of the navigational channel.

The lake lies at an elevation of 255 meters (841 feet) above sea level in the Talbot River watershed which is part of the Severn River Drainage Basin. This watershed is approximately 45 km^2 (17 square miles) in area and water enters Mitchell Lake from Balsam Lake via the Trent Canal and from Grass Creek at the southeastern end of the lake. At the north end of Mitchell Lake is a small wooden dam built in approximately 1910-1911 on the Grass Creek outflow. The purpose of this dam is to keep Mitchell Lake at a suitable depth for navigation in the channel. At the end of the navigational season the guard gates between Balsam and Mitchell lakes are closed, and the dam opened allowing Mitchell Lake to drop approximately 90-120 centimeters (3-4 feet). This elevation is then kept during the winter months until spring when the lake level rises to that of Balsam Lake at which time the guard gates are re-opened. The water that leaves Mitchell Lake, by overflowing the dam, exits to the Talbot River and from there to Canal Lake.

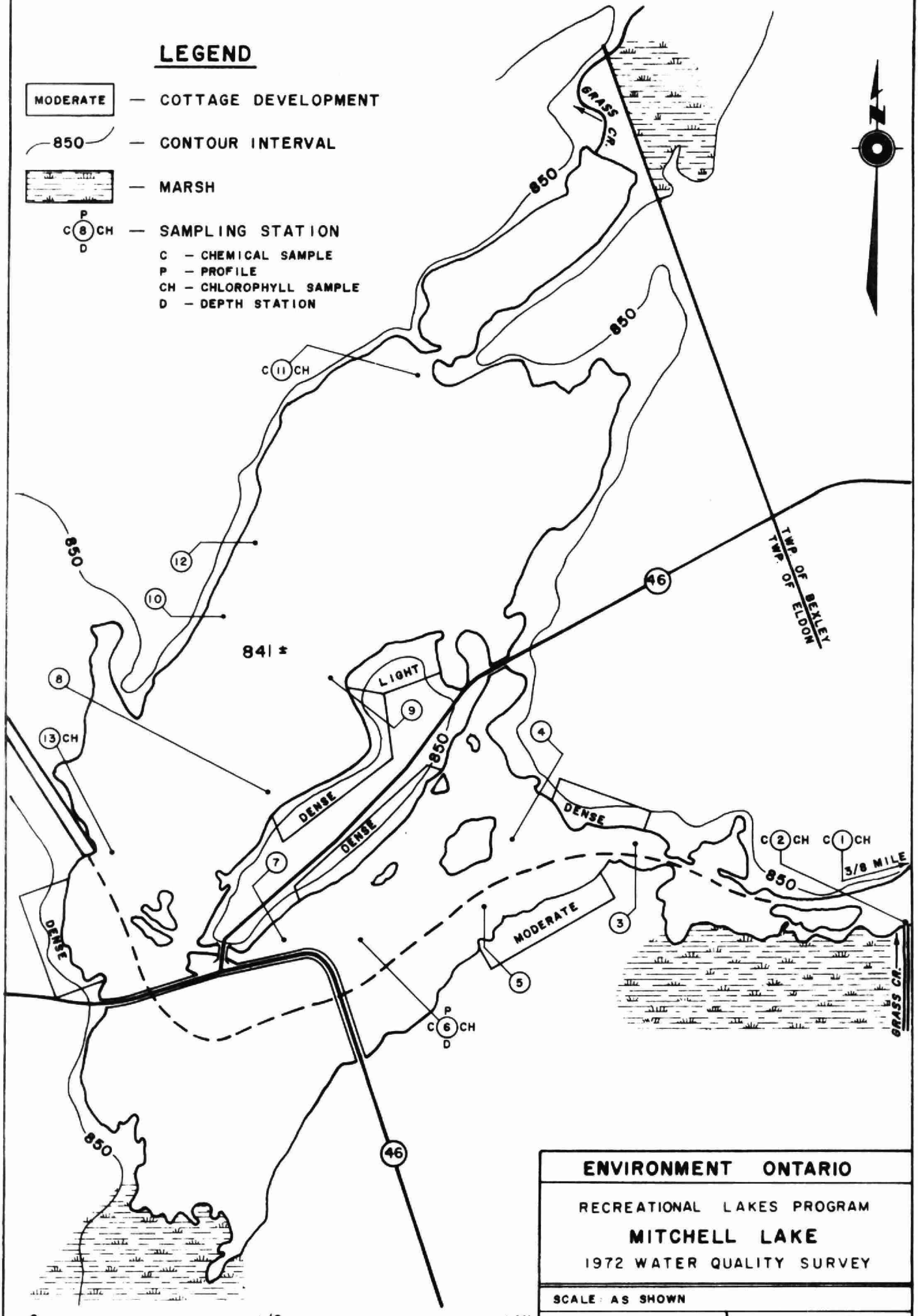
Shoreline Development

Approximately 110 cottages exist on Mitchell Lake, mainly on the east and south shores where dense regions of development can be found. The remaining perimeter of the lake consists of both open field and several bush areas.

Water Usage

Mitchell Lake lies within the Trent-Severn Waterway and as such is used extensively for navigational purposes. The navigational channel crosses the

FIGURE 2 - COTTAGE DEVELOPMENT AND SAMPLING STATIONS OF MITCHELL LAKE



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RECREATIONAL LAKES PROGRAM MITCHELL LAKE 1972 WATER QUALITY SURVEY	
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lake from east to west and is approximately 50 feet wide. Outside of this channel little fishing or swimming can be enjoyed because of submerged stumps and weed patches. There is one route, north of the channel, which follows and old Grass Creek river bed. This route has been marked by the local inhabitants. Most cottages have private wells; however, a few rely on the lake for their source of domestic water.

RESULTS AND DISCUSSION

Bacteriology

The quantities of bacteriological data necessitated statistical methods to summarize the results into a concise presentation without the inconsistency associated with manual interpretation. The methods used are based on the analysis of variance and Barlett's test of homogeneity by which stations on a lake can be grouped into areas with the same bacterial level. Areas or stations with only slight differences in bacterial concentration can be isolated. It was found on previous work that areas, or stations, with significantly higher bacterial numbers generally indicated a pollution input. Details of statistical methods and data are available on request.

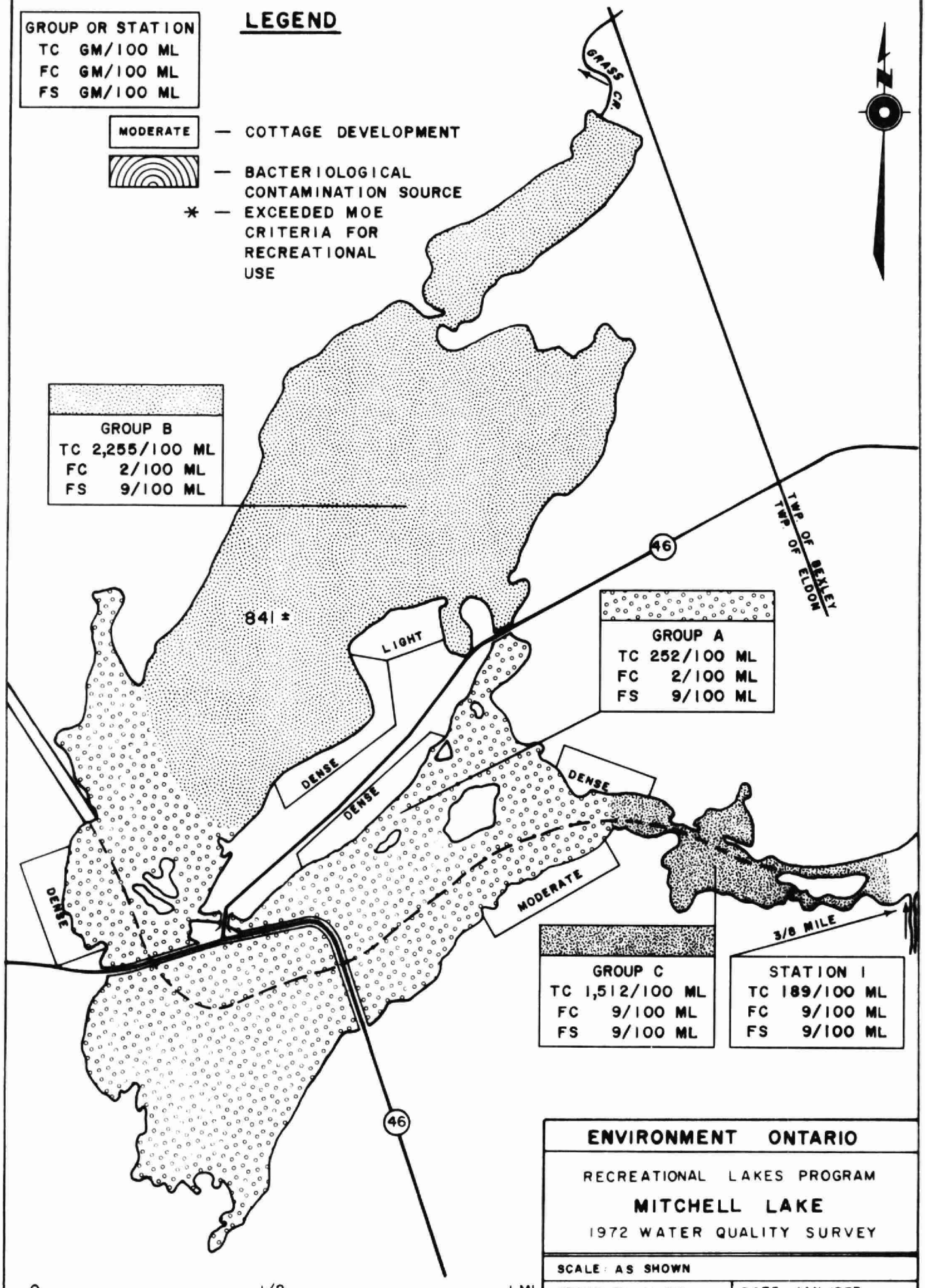
The water quality of Mitchell Lake during the spring, summer and fall surveys was found to be satisfactory and well-within the Ministry of the Environment Criteria for total body contact use (MOE 1972), which states:

> "Where ingestion is probable, recreational waters can be considered impaired when the coliform (TC), fecal coliform (FC) and/or enterococcus (FS) geometric mean density exceeds 1000, 100 and/or 20 per 100 ml respectively...". (1)

During the period from June 8 to June 12, the major southern portion of Mitchell Lake (Group A) had 252 TC, 2 FC and 9 FS/100 ml (Figure 3). The

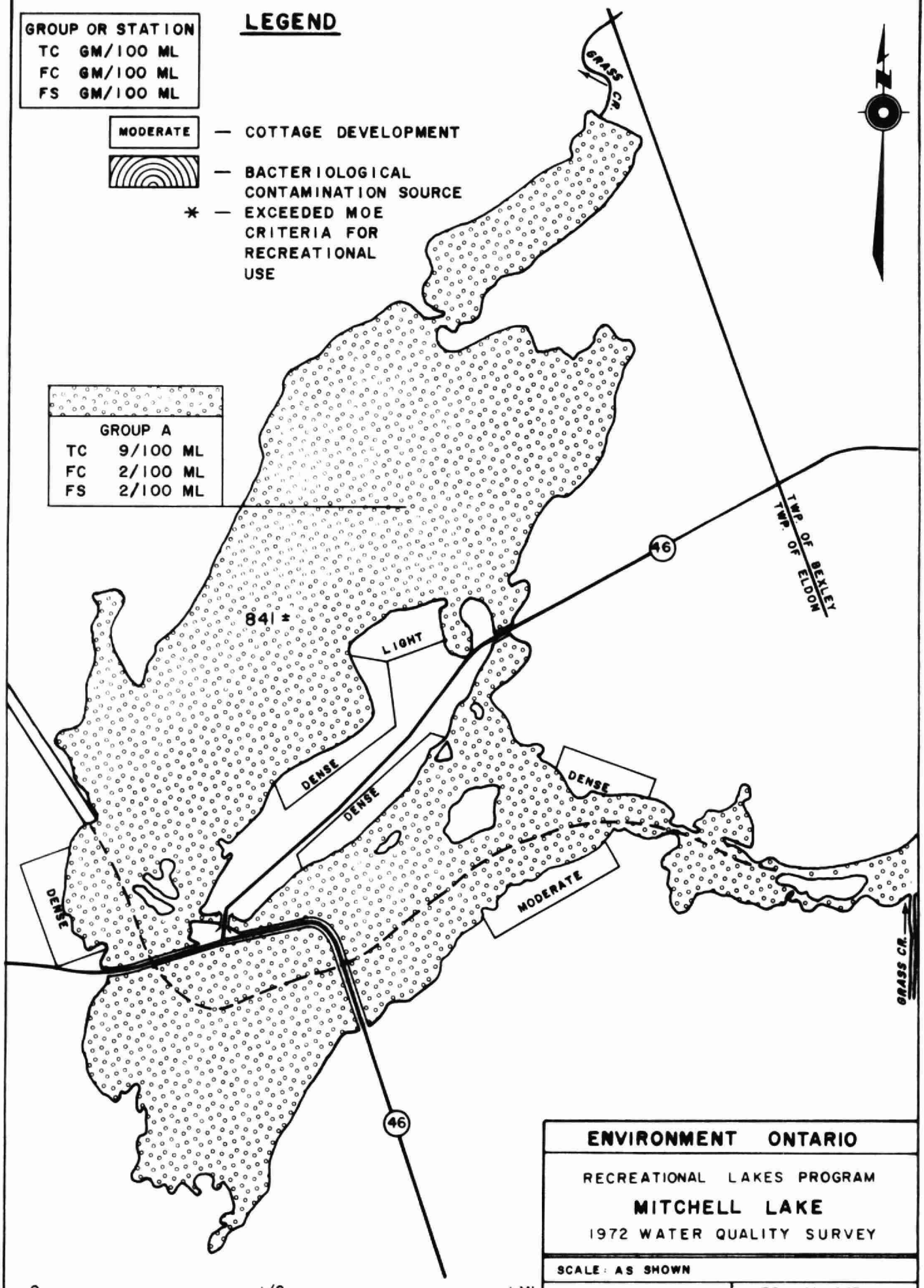
(1) Guidelines and Criteria for Water Quality Management in Ontario. MOE, 1972

FIGURE 3 - DISTRIBUTION OF BACTERIA IN JUNE



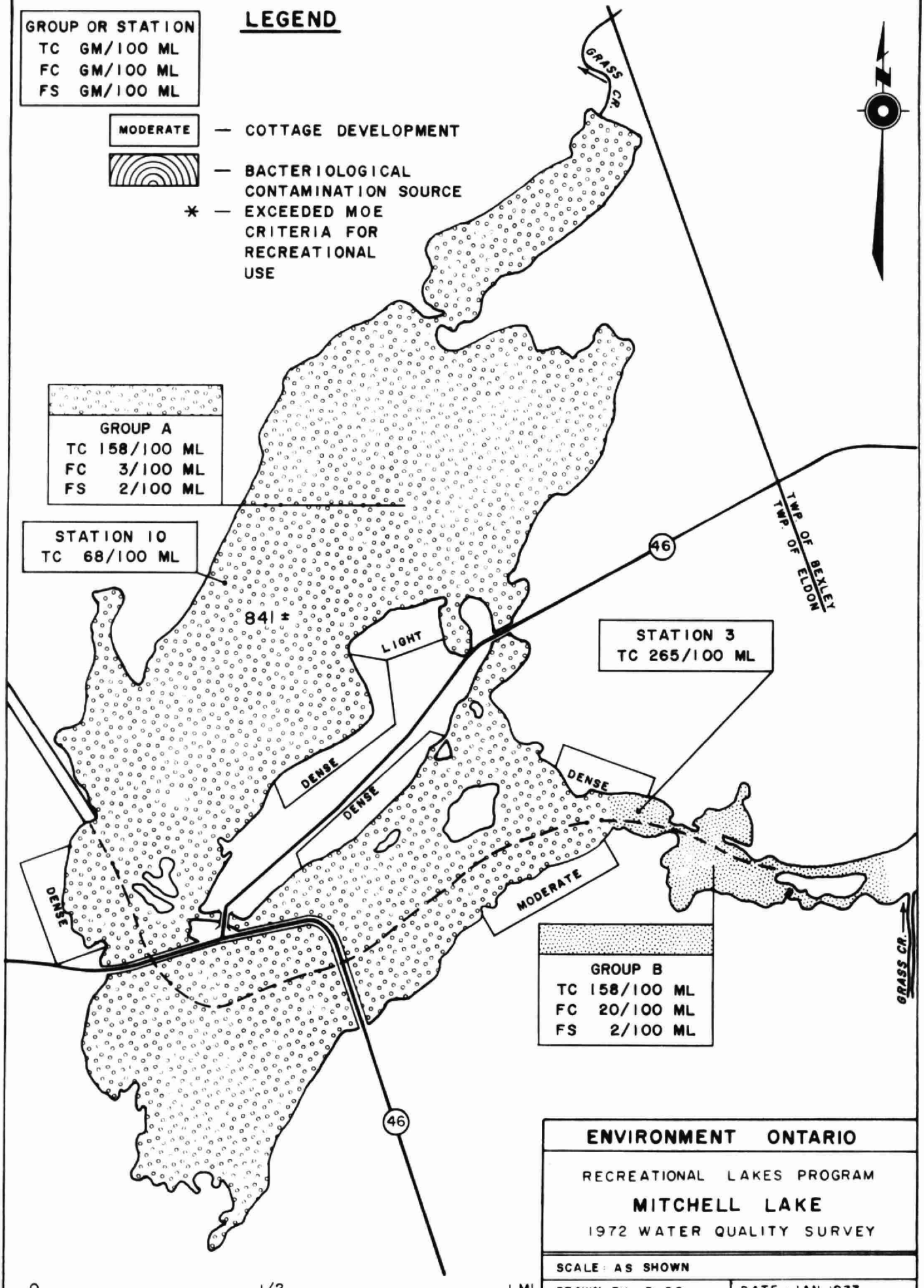
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FIGURE 4 - DISTRIBUTION OF BACTERIA IN AUGUST



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FIGURE 5 – DISTRIBUTION OF BACTERIA IN SEPTEMBER



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northern basin of the lake (Group B) had 2 FC and 9 FS/100 ml while the total coliform levels in this area exceeded the Ministry's criteria with a mean of 2255 TC/100 ml. The area at the extreme eastern section of the lake (Group C), within the influence of the Trent Canal and Grass Creek was characterized by levels of 1512 TC, 9 FC and 9 FS/100 ml (Figure 3).

In September, Mitchell Lake had overall geometric means for most of the lake (Group A) of 158 TC, 3 FC and 2 FS/100 ml (Figure 5). Slightly lower TC levels (68/100 ml) were encountered at Station 10, while the inflow from the Trent Canal and Grass Creek (Group B) had higher FC geometric mean levels of 20 FC/100 ml, indicating sources of pollution. Additional studies would be necessary to determine the source(s) of this pollution.

Since no significant rainfall was recorded at the Coboconk Meteorological Station during the surveys, bacteriological findings reflect dry weather conditions only (see p. A-2 for explanation of "Rainfall Effect").

Chemistry

Water temperatures were uniform throughout the shallow depth of the lake during all three surveys indicating the effectiveness of the wind in maintaining a well-mixed water column. Similarly, dissolved oxygen saturations were near or above 100 percent at all sampling locations during all surveys.

Generally the lake can be considered a moderately hard water system with alkalinity ranging from 45 to 79 mg $CaCO_3$/l , hardness from 58 to 94 mg $CaCO_3$/l and conductivity from 124 to 184 umhos/cm. A trend to lower mineral concentrations from spring to fall was indicated throughout the lake. For example, at Stations 11 and 13 (the two outflows from the lake), conductivity in June decreased from 180 to 170 umhos/cm to 137 and 133 umhos/cm, respectively,

by the September survey. Such decreases were probably brought about by the photosynthetic activity of the abundant aquatic plants in the lake resulting in the extraction of carbon dioxide from the water and the precipitation of calcium carbonate on the lake bottom, logs and stumps, etc. Chloride concentrations were uniformly low throughout the lake averaging 3-5 mg/l over the three surveys. Iron concentrations were frequently undetectable (less than 0.05 mg/l) at all stations and never exceeded 0.3 mg/l (recorded at Station 13 during the June survey).

Total phosphorus and total kjeldahl nitrogen concentrations were generally far below those concentrations generally associated with troublesome amounts of suspended algae. Total phosphorus levels for example, were frequently less than 10 µg/l while total kjeldahl nitrogen concentrations were generally in the 0.30 to 0.40 mg/l range. Nitrate-nitrogen concentrations at the outflows were always below or near the analytical limit of detection (10 µg N/l) and were probably representative of the main body of the lake. Particulate material from the bottom sediments of the lake is probably incorporated into the surface waters on windy days. This would explain the extreme short term variations in total-P concentrations observed at Stations 6 and 13 ranging from 7 to 22 µg P/l and from 8 to 27 µg P/l, respectively during the 5-day August survey.

Chlorophyll a and Water Clarity

Highly enriched lakes exhibit their symptoms of enrichment in several ways (see page A-9 for an explanation of the relationships between nutrient enrichment, lake water clarity and abundance of suspended algae). Because the highly productive status of Mitchell Lake is reflected by very dense growths of aquatic plants, an index of the status of enrichment of the lake based on chlorophyll a and water clarity is probably not justified. The lake was characterized

by small quantities of suspended algae with chlorophyll a concentrations at the mid-lake station averaging 2.1 µg/l. Slightly higher concentrations ranging from 2.2 to 4.0 µg/l were present during the June survey than during the spring and fall surveys. The Secchi disc was visible on the bottom of the lake (2 m) during all three surveys. Following the initial summer growth of suspended algae, the aquatic plant community utilized available nutrients to the extent that they were no longer available for free-floating algal growths. Consequently, high chlorophyll a concentrations were not observed during the remainder of the growing season. It is well known that shallow lakes with fertile bottom deposits (such as Mitchell Lake) often support excessive amounts of aquatic plant growth. In such lakes, suspended algal dnesities are usually very low as a result of either nutritional or antibiotic inhibition by aquatic plants.

Aquatic Plants

An aquatic plant survey was carried out during the second week of August 1972 by staff of the Ministry to determine species distribution, density and nitrogen and phosphorus content of aquatic plants in Mitchell Lake. Results of part of this work are presented here.

The lake, especially the eastern and western bays, is heavily overgrown with aquatic plants (Figure 6). The Trent Canal passing through the lake was dredged initially to facilitate boat traffic which has helped to keep the canal free of plant growth. Periodic mechanical removal of plants from the canal has been necessary in the past as well. Water Star Grass (Heteranthera dubia) were the dominent plants with the former widespread throughout the lake and dense growths of the latter existing in the south end of the lake. Other species present included:

Richardson's Pondweed (Potamogeton richardsonii)
Flat-stemmed Pondweed (Potamogeton zosteriformis)
Canada Waterweed (Elodea canadensis)
Bushy Pondweed (Najas flexilis)
Milfoil (Myriophyllum sp.)
Coontail (Ceratophyllum demersum)
*Stonewort (Chara sp.)

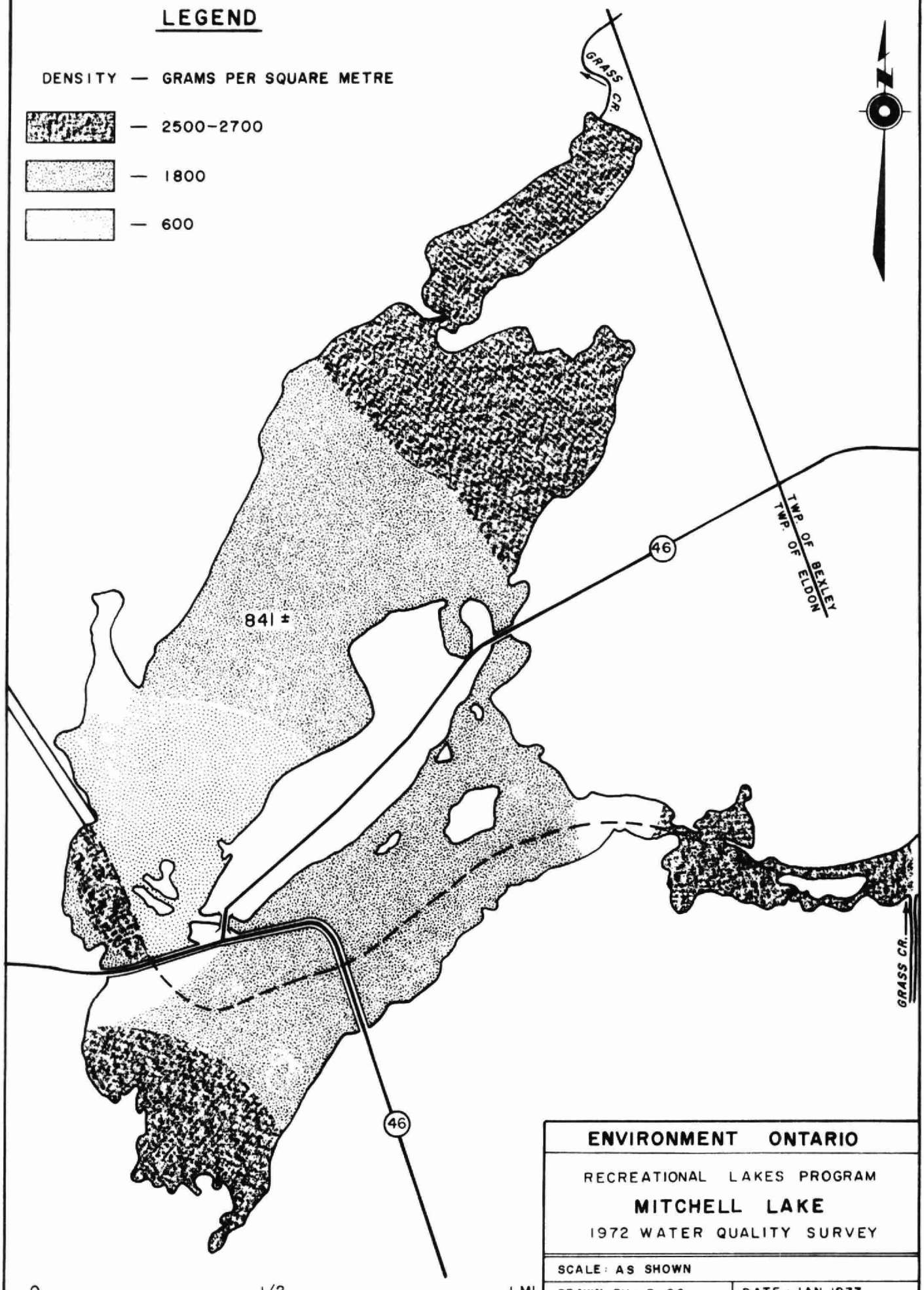
Quadrat methods of sampling and subsequent analysis of harvested plant material enabled estimates to be made of the total amount of plant material in the lake and total nitrogen and phosphorus content of the plants as follows:

**Plant Mass (Metric Tons)		Nutrient Content	
Fresh weight	Dry Weight	Nitrogen (metric tons)	Phosphorus (metric tons)
7500	800	23	2.7

Considering that much of the nutrient content of plants may be released to the water during decomposition, large scale harvesting of aquatic plants would represent a significant removal of nutrients from the lake. Pending results of experiments to determine the ecological and economical suitability of large scale mechanical harvesting of aquatic plants on Chemung Lake (see page A-9), mechanical removal of aquatic plant growth may find application as a water management tool to enhance water use potential in Mitchell Lake.

*Chara is technically an alga but because it grows in long strands, it is often referred to as an aquatic plant.
**1 metric ton x 1.1 = 1 short ton

FIGURE 6 - DENSITY OF AQUATIC PLANT GROWTH IN MITCHELL LAKE



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INFORMATION OF GENERAL INTEREST TO COTTAGERS
MICROBIOLOGY OF WATER

For the sake of simplicity, the microorganisms in water can be divided into two groups: the bacteria that thrive in the lake environment and make up the natural bacterial flora; and the disease causing micro-organisms, called pathogens, that have acquired the capacity to infect human tissues.

The "pathogens" are generally introduced to the aquatic environment by raw or inadequately treated sewage, although a few are found naturally in the soil. The presence of these bacteria does not change the appearance of the water but pose an immediate public health hazard if the water is used fro drinking or swimming. The health hazard does not necessarily mean that the water user will contract serious waterborn infections such as typhoid fever, polio or hepatitis, but he may catch less infections of gastroenteritis (sometimes called stomach flu), dysentery or diarrhea. Included in these minor afflictions are eye, ear and throat infections that swimmers encounter every year and the more insidious but seldom diagnosed, subclinical infections usually associated with several water born viruses. These viral infections leave a person not feeling well enough to enjoy holidaying although not bedridden. This type of microbial pollution can be remedied by preventing wastes from reaching the lake and water quality will return to satisfactory conditions within a relatively short time (approximately 1 year) since disease causing bacteria ususally do not thrive in an aquatic environment.

The rest of the bacteria live and thrive within the lake environment. These organisms are the instruments of biodegradation. Any organic

matter in the lake will be used as food by these organisms and will give rise, in turn to subsequent increases in their numbers. Natural organic matter as well as that from sewage, kitchen wastes, oil and gasoline are readily attached by these lake bacteria. Unfortunately, biodegradation of the organic wastes by organisms uses correspondingly large amounts of the dissolved oxygen. If the organic matter content of the lake gets high enough, these bacteria will deplete the dissolved oxygen supply in the bottom waters and threaten the survival of many deep water fish species.

The standard plate count (SPC) populations given in the text supply an indication of the number of these bacteria in the lake.

RAINFALL AND BACTERIA

The "Rainfall Effect" referred to in the text, relates to a phenomena that has been documented in previous surveys of the Recreational Lakes. Heavy precipitation has been shown to flush the land area around the lake and the subsequent runoff will carry available contaminants including sewage organisms as well as natural soil bacteria with it into the water.

Total coliforms, fecal coliforms and fecal streptococci, as well as other bacteria and viruses which inhabit human waste disposal systems, can be washed into the lake. In Precambrian areas where there is inadequate soil cover and in fractured limestone areas where fissures in the rocks provide access to the lake, this phenomenon is particularly evident.

Melting snow provides the same transportation function for bacteria, especially in an agricultural area where manure spreading is carried out in the winter on top of the snow.

Previous data from sampling points situated 50 to 100 feet from shore indicate that contamination from shore generally shows up within 12 to 48 hours after a heavy rainfall.

WATER TREATMENT

Lake and river water is open to contamination by man, animals and birds (all of which can be carriers of disease); consequently, NO SURFACE WATER MAY BE CONSIDERED SAFE FOR HUMAN CONSUMPTION without prior treatment, including disinfection. Disinfection is especially critical if coliforms have been shown to be present.

Disinfection can be achieved by:

(a) Boiling

B oil the water for a minimum of five minutes to destroy the disease causing organisms.

(b) Chlorination Using a Household Bleach Containing 4 to 5.1/4% Available Chlorine

Eight drops of a household bleach solution should be mixed with one gallon of water and allowed to stand for 15 minutes before drinking.

(c) Continuous Chlorination

For continuous water disinfection, a small domestic hypochlorinator (sometime coupled with activated charcoal filters) can be obtained from a local plumber or water equipment supplier.

(d) Well Water Treatment

Well water can be disinfected using a household bleach (assuming

strength at 5% available chlorine) if the depth of water and diameter of the well are known.

CHLORINE BLEACH
per 10 ft depth of water

Diameter of Well Casing In Inches	One to Ten Coliforms	More than Ten Coliforms
4	.5 oz	1 oz.
6	1 oz.	2 oz.
8	2 oz.	4 oz.
12	4 oz.	8 oz.
16	7 oz.	14 oz.
20	11 oz.	22 oz.
24	16 oz.	31 oz.
30	25 oz.	49 oz.
36	35 oz.	70 oz.

Allow about six hours of contact time before using the water.

Another bacteriological sample should be taken after one week of use.

Water Sources (spring, lake, well, etc.) should be inspected for possible contamination routes (surface soil, runoff following rain and seepage from domestic waste disposal sites). Attempts at disinfecting the water alone without removing the source of contamination will not supply bacteriologically safe water on a continuing basis.

There are several types of low cost filters (ceramic, paper, carbon, diatomaceous earth sometimes impregnated with silver, etc.) that can be easily installed on taps or in water lines. These may be useful to remove particles if water is periodically turbid and are usually very successful. Filters, however, do not disinfect water but may reduce bacterial numbers. For safety, chlorination of filtered water is recommended.

SEPTIC TANK INSTALLATIONS

In Ontario, provincial law requires that you obtain permission in writing to install a septic tank system. Permission can be obtained from the local Medical Officer of Health or in some instances from the Regional Engineer of the Ministry of the Environment. Any other pertinent information such as sizes, types and location of septic tanks and tile fields can also be obtained from the same authority.

(i) General Guidelines

A septic tank should not be closer than:

-50 feet to any well, lake, stream or pond.
-5 feet to any building.
-10 feet to any property boundary

The tile field should not be closer than:

-100 feet to the nearest dug well.
-50 feet to a drilled well which has a casing to 25 feet below ground.
-25 feet to a building
-10 feet to a property boundary.
-50 feet to any lake, stream or pond.

The ideal location for a tile field is in a well drained, sandy loam soil remote from any wells or other drinking water sources. For the tile field to work satisfactorily, there should be at least 3 feet of soil between the bottom of the weeping tile trenches and the top of the ground water table or bedrock.

DYE TESTING OF SEPTIC TANK SYSTEMS

There is considerable interest among cottage owners to dye test their sewage systems, however, several problems are associated with dye testing. Dye would not be visible to the eye from a system that has a fairly direct

connection to the lake. Thus, if a cottager dye-tested his system and no dye was visible in the lake, he would assume that his system is satisfactory, which might not be the case. A low concentration of dye is not visible and therefore expensive equipment such as a fluorometer is required. Only qualified people with adequate equipment are capable of assessing a sewage system by using dye. In any case, it is likely that some of the water from a septic tank will eventually reach the lake. The important question is whether all contaminants including nutrients have been removed before it reaches the lake. To answer this question special knowledge of the system, soil depth and composition, underground geology of the region and the shape and flow of the shifting water table are required. Therefore, we recommend that this type of study should be performed only by qualified professionals.

BOATING REGULATION

In order to help protect the lakes and rivers of Ontario from pollution it is required by law that sewage (including garbage) from all pleasure craft, including houseboats must be retained in equipment of a type approved by the Ministry of the Environment. Equipment which will be approved by the Ministry of the Environment includes (1) retention devices with or without circulation which retain all toilet wastes for disposal ashore, and (2) incinerating devices which reduce all sewage to ash.

To be approved, equipment shall:

1. be non-portable,
2. be constructed of structurally sound material,
3. have adequate capacity for expected use
4. be properly installed,

5. in the case of storage devices, be equipped with the necessary pipes and fittings conveniently located for pump-out by shore-based facilities (although not specified, a pump-out deck fitting with 1.1/2 inch National Pipe Thread is commonly used).

An Ontario regulation requires that marinas and yacht clubs provide or arrange pump-out service for the customers and members who have toilet-equipped boats. In addition, all marinas and yacht clubs must provide litter containers that can be conveniently used by occupants of pleasure boats.

The following "Tips" may be of assistance to you in regards to boating:

1. Motors should be in good mechanical condition and properly tuned.

2. When a tank for outboard motor testing is used, the contents should not be emptied into the water.

3. Fuel hoses must be in good condition and all connections tight.

4. If the bilge is cleaned prior to the boating season, the waste material must not be dumped into the water.

5. Fuel tanks must not be overfilled and space must be left for expansion if the fuel warms up.

6. Vent pipes should not be obstructed and fuel needs to be dispensed at a correct rate to prevent "blow-back".

7. Empty oil cans must be deposited in a leak-proof receptacle.

ICE-ORIENTED RECREATIONAL ACTIVITIES

The Ministry of the Environment is presently preparing regulations to control pollution from ice-oriented recreational activities. In past years, there has been indiscrimate dumping of garbage and sewage on the ice. The bottoms of fish huts have been left on the ice and become a navigational hazard to boaters in the spring. Broken glass has been left on the ice only to become

injurious to swimmers. With the anticipated introduction of the regulations, many of these abuses will become illegal.

EUTROPHICATION OR EXCESSIVE FERTILIZATION AND LAKE PROCESSES

The changes in water quality brought about by excessive inputs of nutrients to lakes are usually evidenced by excessive growths of algae and aquatic plants.

Aquatic plants and algae are important in maintaining a balanced aquatic environment. They provide food and a suitable environment for the growth of aquatic invertebrate organisms which serve as food for fish. Shade from large aquatic plants helps to keep the lower water cool which is essential to certain species of fish and also provide protection for young game and forage fish. Numerous aquatic plants are utilized for food and/or protection by many species of waterfowl. However, too much growth creates an imbalance in the natural plant and animal community particularly with respect to oxygen conditions, and some desirable forms of life such as sport fish are eliminated and unsightly algae scums can form. The lake will not be "dead" but rather abound with life which unfortunately is not considered aesthetically pleasing. This change to poor water quality becomes apparent after a period of years in which extra nutrients are added to the lake and a return to the natural state may also take a number of years after the nutrient inputs are stopped. Changes in water quality with depth are a very important characteristic of a lake. Water temperatures are uniform throughout the lake in the early spring and winds generally keep the entire volume well mixed. Shallow lakes may remain well mixed all summer so that water quality will be the same throughout. On the other hand, in deep lakes, the surface waters

warm up during late spring and early summer and float on the cooler more dense water below. The difference in density offers a resistance to mixing by wind action and many lakes do not become fully mixed again until the surface waters cool down in the fall. The bottom water receives no oxygen from the atmosphere during this unmixed period and the dissolved oxygen supply may be all used up by bacteria as they decompose organic matter. Cold water fish, such as trout, will have to move to the warm surface waters to get oxygen and because of the high water temperatures they will not thrive, so that the species will probably die out (see Figure next page).

Low oxygen conditions in the bottom waters are not necessarily an indication of pollution but excessive aquatic plant and algae growth and subsequent decomposition can aggravate the condition and in some cases can result in zero oxygen levels in lakes which had previously held some oxygen in the bottom waters all summer. Although plant nutrients normally accumulate in the bottom waters of lakes, they do so to a much greater extent if there is no oxygen present. These nutrients become available for algae in the surface waters when the lake mixes in the fall and dense algae growths can result. Consequently, lakes which have no oxygen in the bottom water during the summer are more prone to having algae problems and are more vulnerable to nutrient inputs than lakes which retain some oxygen.

CONTROL OF AQUATIC PLANTS AND ALGAE

Usually aquatic weed growths are heaviest in shallow shoreline areas where adequate light and nutrient conditions prevail.

Extensive aquatic plant and algal growths sometimes interfere with

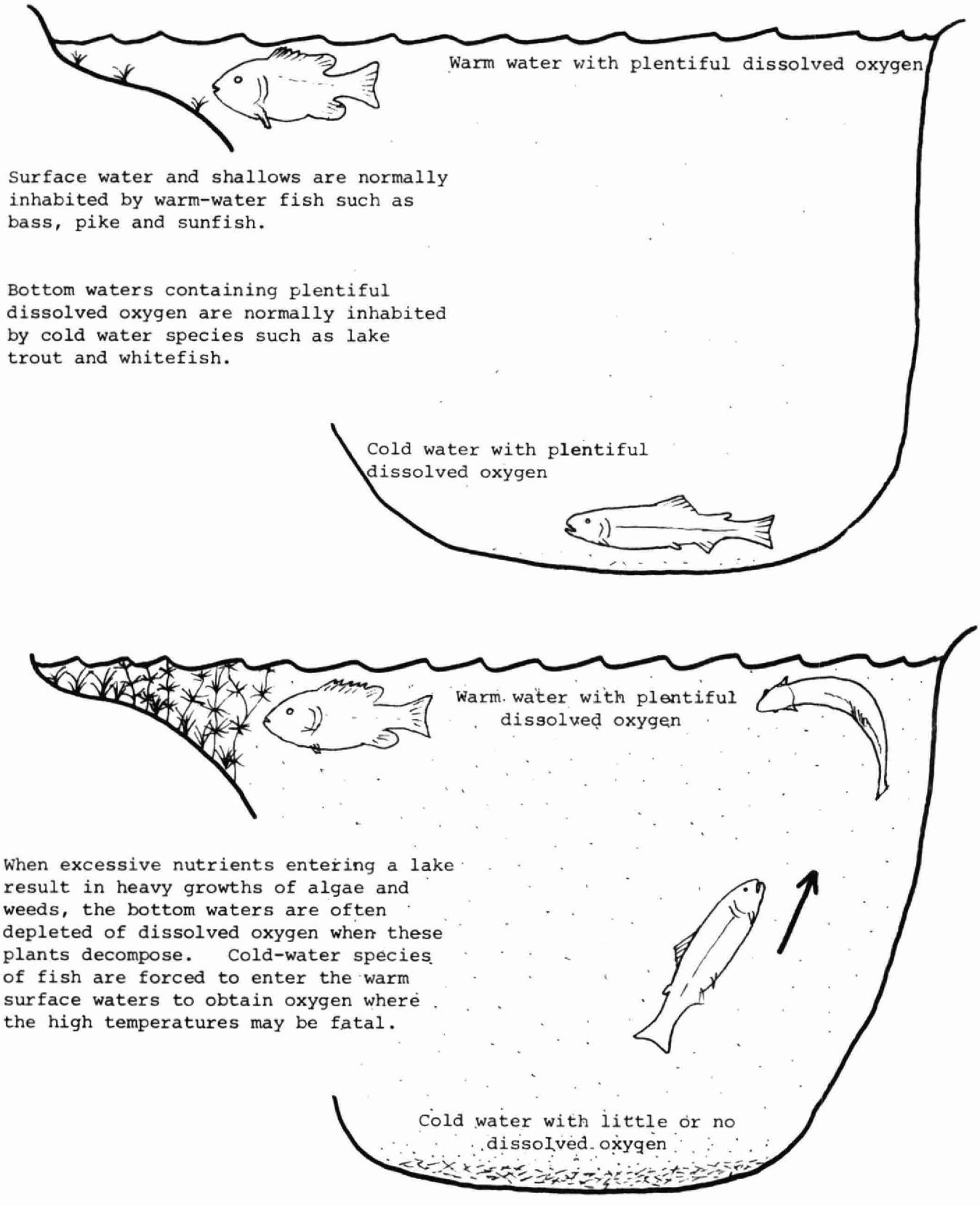


FIGURE A-1: DECOMPOSITION OF PLANT MATTER AT THE LAKE BOTTOM CAN LEAD TO DEATH OF DEEP-WATER FISH SPECIES.

boating and swimming and ultimately diminish shoreline property values.

Control of aquatic plants may be achieved by either chemical or mechanical means. Chemical methods of control are currently the most practical, considering the ease with which they are applied. However, the herbicides and algicides currently available generally provide control for only a single season. It is important to ensure that an algicide or herbicide which kills the plants causing the nuisance, does not affect fish or other aquatic life and should be reasonable in cost. At the present time, there is no one chemical which will adequately control all species of algae and other aquatic plants. Chemical control in the province is regulated by the Ministry of the Environment and a permit must be granted prior to any operation. Simple raking and chain dragging operations to control submergent species have been successfully employed in a number of situations; however, the plants soon re-establish themselves. Removal of weeds by underwater mowing techniques is certainly the most attractive method of control and is currently being evaluated in Chemung Lake near Peterborough. Guidelines and summaries of control methods, and applications for permits are available from the Biology Section, Water Quality Branch, Ministry of the Environment, Box 213, Rexdale, Ontario.

PHOSPHORUS AND DETERGENTS

Scientists have recognized that phosphorus is the key nutrient in stimulating algal and plant growth in lakes and streams.

In the past years, approximately 50% of the phosphorus contributed by municipal sewage was added by detergents. Federal regulations reduced

the phosphate content as P_2O_5 in laundry detergents from approximately 50% to 20% on August 1, 1970 and to 5% on January 1, 1973.

It should be recognized that automatic dishwashing compounds were not subject to the recently approved government regulations and that surprisingly high numbers of automatic dishwashers are present in resort areas (a questionnaire indicated that about 30% of the cottages in the Muskoka Lakes have automatic dishwashers). Cottagers utilizing such conveniences may be contributing significant amounts of phosphorus to recreational lakes. Indeed, in most of Ontario's vacation land, the source of domestic water is soft enough to allow the exclusive use of liquid dishwashing compounds, soap and soap-flakes.

ONTARIO'S PHOSPHORUS REMOVAL PROGRAM

By 1975, the Government of Ontario expects to have controls in operation at more than 200 municipal wastewater treatment plants across the province serving some 4.7 million persons. This represents about 90% of the population serviced with sewers. The program is in response to the International Joint Commission recommendations as embodied in the Great Lakes Water Quality Agreement and studies carried out by the Ministry of the Environment on inland recreational waters which showed phosphorus to be a major factor influencing eutrophication. The program makes provision for nutrient control in the Upper and Lower Great Lakes, the Ottawa River system and in prime recreational waters where the need is demonstrated or where emphasis is placed upon prevention of localized eutrophication.

Phosphorus removal facilities must be operational at wastewater treatment plants by December 31, 1973, in the most critically affected areas

of the province, including all of the plants in the Lake Erie drainage basin and the inland recreational areas. The operational date for plants discharging to waters deemed to be in less critical condition which includes plants larger than one million gallons per day (1 mgd) discharging to Lake Ontario and to the Ottawa River system, is December 31, 1975. The 1973 phase of the program will involve 156 plants of which 85 are in the Lake Erie basin and another 30 in the Lake Huron drainage basin. The capacities of these plants range from 0.04 to 24.0 mgd, serving an estimated population of 1,600,000 persons. The 1975 phase will bring into operation another 57 plants ranging in size from 0.3 to 180 mgd serving an additional 3,100,000 persons. Treatment facilities utilizing the Lower Great Lakes must meet effluent guidelines of less than 1.0 milligrams per litre of total phosphorus in their final effluent. Facilities utilizing the Upper Great Lakes, the Ottawa River Basin and certain areas of Georgian Bay where needs have been demonstrated must remove at least 80% of the phosphorus reaching their sewage treatment plants.

CONTROL OF BITING INSECTS

Mosquitoes and blackflies often interfere with the enjoyment of recreational facilities at the lake-side vacation property. Pesticidal spraying or fogging in the vicinity of cottages produces extemely temporary benefits and usually do not justify the hazard involved in contaminating the nearby water. Eradication of biting fly populations is not possible under any circumstances and significant control is rarely achieved in the absence of large-scale abatement programmes involving substantial funds and trained personnel. Limited use of approved

larvicides in small areas of swamp or in rain pools close to residences on private property may be undertaken by individual landowners, but permits are necessary wherever treated waters may contaminate adjacent streams or lakes. The use of repellents and light traps is encouraged as are attempts to reduce mosquito larval habitat by improving land drainage. Applications for permits to apply insecticides as well as technical advice can be obtained from the Biology Section, Water Quality Branch of the Ministry of the Environment, Box 213, Rexdale, Ontario.

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